Computation of MHD Parameters in the LFM model

1. Pressure

In ideal MHD model [*Gombosi*, 1998],

$$\varepsilon = \frac{1}{2}\rho \mathrm{v}^2 + \frac{p_{th}}{\gamma - 1} \qquad (1)$$

where ε is the sum of flow and thermal energy density,
ρ is mass density,
v is flow velocity,
p_{th} is thermal pressure, and
$\gamma = 5/3$, is the polytropic index.

Eq. (1) can be rearranged as,

$$\begin{aligned}\frac{2}{3}\varepsilon &= \frac{1}{3}\rho \mathrm{v}^2 + p_{th} \\ &= p_{dyn} + p_{th} \qquad (2)\end{aligned}$$

where p_{dyn} = dynamic pressure = $\frac{1}{3}\rho \mathrm{v}^2$

p_{th} = thermal pressure = nkT

2. Mean Energy

Mean energy, $\overline{E}$, is given by,

$$\overline{E} = \frac{\varepsilon}{n} \qquad (3)$$

where n is number density. Combining Eqs. (2) and (3), $\overline{E}$ can be obtained by,

$$\overline{E} = \frac{3}{2}\frac{p_T}{n} \qquad (4)$$

where $p_T = p_{dyn} + p_{th}$ is the total pressure.

Reference:

Gombosi, T. I, *Physics of the Space Environment*, Cambridge, New York, 1998